

1 THE EMBODIMENTS OF THE INVENTION IN WHICH AN
2 EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS
3 FOLLOWS:
4

5 1. A method for drilling a subterranean formation comprising the
6 steps of:

7 rotating a PDC drill bit; and

8 periodically imparting a rotary impact into the drill bit.

9
10 2. The method of claim 1 wherein imparting of the rotary impact
11 comprises the steps of:

12 rotating an inertial hammer to store potential energy; and

13 periodically impacting the rotating inertial hammer with a rotary anvil on
14 the drill bit so as to impart the stored potential energy to the drill bit.

15
16 3. The method of claim 1 wherein the rotary impact is only
17 imparted to the drill bit when the drill bit bears against the formation.
18

1 4. A method for drilling a subterranean formation with a PDC drill
2 bit depending from a drill string, the method comprising the steps of:
3 providing an assembly adjacent the drill bit;
4 rotating the assembly to rotate the drill bit; and
5 periodically impacting the rotating hammer with an anvil on the drill bit
6 so as to impart the stored potential energy to the drill bit.

7
8 5. The method as described in claim 4 wherein the hammer is
9 rotated using drilling fluid.

10
11 6. A rotational impact assembly for a drill bit comprising:
12 a housing adapted to be rotated by a rotary drive;
13 a bit extending from the housing and being rotatably driven thereby;
14 and
15 a rotary drive located in the housing for periodically and rotatably
16 impacting the drill bit.

17
18 7. The rotational impact assembly of claim 6 wherein the housing
19 further comprises a bit shaft through which the drill bit is rotatably driven.

20 8. The rotational impact assembly of claim 7 wherein the bit shaft
21 is adapted for limited rotational freedom relative to the housing so that when
22 rotationally impacted, the bit shaft can rotate slightly and independent of the housing

1 rotation whereby the drill bit receives substantially all of the rotary impact without
2 engaging the housing.

3
4 9. The rotational impact assembly of claim 6 wherein the rotary
5 drive is a motor driven by drilling fluids.

6
7 10. The rotational impact assembly of claim 6 wherein the rotary
8 drive is driven by a drill string.

9
10 11. The rotational impact assembly of claim 9 wherein the motor is
11 a turbine.

12
13 12. The rotational impact assembly of claim 9 further wherein the
14 motor comprises a stator shaft having a first downhole position and in which a
15 frictional interface is engaged between the stator shaft and the housing to prevent
16 operation of the motor, and a second uphole position in which the frictional interface
17 is disengaged for permitting operation of the motor.

1 13. A rotational impact assembly for a drill bit comprising:
2 a housing adapted to be rotated by a rotary drive, the housing having a
3 bore;
4 a motor located in the bore for rotating a stator shaft;
5 a bit shaft extending from the bore of the housing and being adapted at
6 a downhole end for rotatably driving the drill bit; and
7 means for periodically coupling the stator shaft and bit shaft for co-
8 rotation whereby rotational energy is transferred from the stator shaft to the bit shaft.
9

10 14. The rotational impact assembly of claim 13 wherein the coupling
11 means comprise:

12 an annular mass rotated by the stator shaft and having a radially
13 extending hammer; and

14 an anvil extending radially from the bit shaft and adapted to be
15 impacted by the hammer.
16

17 15. The rotational impact assembly of claim 14 further comprising:

18 a carrier driven by the stator shaft and in which the annular mass is
19 carried about the bit shaft;

20 means for alternating the position of the annular mass between
21 concentric and eccentric positions about the bit shaft upon each rotation of the stator
22 shaft, the carrier and annular mass being rotated concentrically so as to cause the

1 hammer and anvil to couple, and the annular mass then moving eccentrically so as
2 to decouple the hammer from the anvil.

3
4 16. The rotational impact assembly of claim 15 wherein the means
5 for alternating the annular mass position comprises:

6 a first pin affixed in the carrier and at a tangent of the annular mass for
7 enabling the annular mass to pivot eccentrically;

8 a second pin affixed in the carrier diametrically opposed to the first pin
9 and at a tangent of the annular mass, the annular mass having circumferentially
10 elongated notch formed in its tangent for permitting limited the eccentric movement
11 of the annular mass, the eccentric movement being sufficient to decouple the
12 hammer and anvil.

13
14 17. A rotational impact assembly for a drill bit comprising:

15 a housing adapted to be rotated by a rotary drive, the housing having a
16 bore;

17 a motor located in the bore for rotating a stator shaft;

18 a bit shaft extending from the bore of the housing and being adapted at
19 a downhole end for rotatably driving the drill bit;

20 an annular mass rotated by the stator shaft and having a radially
21 extending hammer; and

1 an anvil extending radially from the bit shaft and adapted to be
2 impacted by the hammer whereby rotational energy is transferred from the stator
3 shaft to the bit shaft.

4
5 18. The rotational impact assembly of claim 17 further comprising:
6 a carrier driven by the stator shaft for carrying the annular mass about
7 the bit shaft;

8 an offset pin in the carrier about which the annular mass can pivot
9 between concentric and eccentric positions about the bit shaft so that upon each
10 rotation of the stator shaft, the carrier and annular mass are rotated concentrically so
11 as to cause the hammer and anvil to couple after which the annular mass pivots to
12 the eccentric position so as to decouple the hammer from the anvil.

13
14 19. The rotational impact assembly of claim 18 further comprising a
15 second pin in the carrier and diametrically opposed to the first offset pin, the annular
16 mass having circumferentially spaced stops which alternately position the annular
17 mass between the concentric and eccentric positions.

18
19 20. The rotational impact assembly of claim 17 wherein the motor is
20 rotated by drilling fluids flowing to the drilling bit.